

How much do Irish Private Forest Owners Know about Forestry?

Áine Ní Dhubháin · Rory Greene

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Abstract Since 1980, over 20,000 Irish landowners have afforested land, for the first time, as part of an afforestation programme subsidised by the Government and the EU. A survey of 99 private forest owners was conducted to determine their knowledge of broad aspects of forest management. Key questions were scored so as to test whether respondents had passed or failed a forestry knowledge test. Over two-thirds of private forest owners passed the test. Success in this test was shown to be related to whether respondents had (a) attended extension field days; (b) been active in forest operations in the early stages of the forest cycle and (c) been members of farming and/or forestry groups. Younger respondents (i.e., ≤ 50 years) were more likely to pass the knowledge test than older respondents.

Keywords Forestry knowledge · Non-industrial private forest owners · Extension · Timber production

Background

Non-industrial private forest (NIPF) lands account for 39% (Schmithüsen and Hirsch 2008) and 40% of European and US forests (Butler and Leatherberry 2004), respectively. In both continents, these forests supply a significant proportion of the industrial timber (Harrison et al. 2002) and their contribution to timber supply is expected to increase in the future (Adams 2002; Hirsch et al. 2007). They are also expected to deliver public benefits such as wildlife habitat and clean water (Belin

Á. N. Dhubháin (✉)

Agriculture and Food Centre, School of Biology and Environmental Science,
University College Dublin, Belfield, Dublin 4, Ireland
e-mail: aine.nidhubhain@ucd.ie

R. Greene

Irish Timber Grower's Association, Dalkey, Co, Dublin, Ireland

et al. 2005). Concerns, however, have been raised about the level of management being implemented in NIPF lands (Toivonen et al. 2005). Many forest owners do not have management plans (Karppinen et al. 2002; Butler and Leatherberry 2004). In some instances there is little active management being undertaken in these forests, with 30% of European NIPF owners showing little motivation as regards the functions of their forests (Wiersum et al. 2005). However, the management being implemented by NIPF owners is influenced by a number of factors including the objectives of the owners (Karppinen 1998). An increasing number of NIPF owners do not rely on income from their forests (Hyttinen 2004). Consequently holding timber production as an objective is declining in importance (Butler and Leatherberry 2004), while the significance of aesthetic objectives is increasing. Many NIPF owners hold multiple objectives for their woods (Marty et al. 1988; Kuuluvainen et al. 1996). The changing profile of these owners in the US and Europe, e.g., increasing urbanization, decreasing numbers of farmer owners, has contributed to this diversity of objectives which is expected to increase further, with unknown consequences for timber supply (Hujala et al. 2007).

Owners' knowledge is also an important factor influencing the management strategies they adopt (Gan and Kollison 1999). Megalos (2000) cited in Wicker (2002) noted that forest owners identified that their lack of knowledge was a significant deterrent to management for timber production. Gan and Kollison (1999) also noted that 38% of NIPF owners surveyed in southeastern Alabama were not managing their forests to improve personal incomes due to their lack of knowledge of how to do so. Forestry extension has been identified as an important means of delivering some of the knowledge needs (Measells et al. 2006). Consequently there have been numerous studies exploring the educational and information needs of forest owners in an effort to develop more effective and targeted extension programmes. However, in many instances, these studies have determined what educational programmes owners have availed of, while also asking owners what aspects of forestry they would like to learn more about (e.g., Downing and Finley 2005; Measells et al. 2006). They have not tended to objectively assess the owners' information needs. Some exceptions include Londo (2004) who measured Mississippi's NIPF owners' knowledge of forestry best management practices by posing particular questions to respondents which were then scored. Similarly Uliczka et al. (2004) tested the knowledge of Swedish forest owners of biodiversity conservation.

In Ireland, the number of NIPF owners has increased substantially since the Government and the EU provided funding for an afforestation programme in Ireland in 1980 (when the forest cover was only 6%; the lowest in Europe). The aim of the initial round of funding was to raise farm incomes in the less favoured areas of Ireland (Nugent 1985) and to reduce the trade deficit that existed in timber products in the EU at the time. Funding for afforestation included a grant which covered 85% of establishment costs. Since 1989 the establishment grant has been cost-based, ensuring that there is no actual cash outflow from the landowner arising from planting. In 1990 the Forest Premium Scheme was introduced providing those afforesting land with an annual premium (in addition to the establishment grant), over a period of 15–20 years, to compensate them for the loss of income arising

from afforestation. The premium continues to be available to new entrants to the scheme and the current annual value of these premiums, which are exempt from income tax, is high ranging from €197 per ha in the case of conifers to €574 per ha in the case of broadleaves.

In the early years of the afforestation programme, marginal agricultural land was typically afforested, usually with exotic conifers such as Sitka spruce, managed over a 45-year rotation. This species had proven itself to be well suited to the climate and growing conditions in Ireland and was shown to have growth rates three times the EU average (DAFF 1996). By 1996, it comprised approximately 60% of the forest estate. In an effort to increase the planting of broadleaf species, which were considered to have greater environmental value than conifers, higher financial incentives for these species were made available in 1987. Since 1992, each plantation for which grant-aid is obtained must comprise at least 10% broadleaves, site permitting (Forest Service 2003); broadleaves currently account for 31% of the afforestation programme and 16% of the national forest estate (Forest Service 2007). In some instances the broadleaves are planted as pure stands; in others the broadleaves are planted around the perimeter of a conifer plantation or within it in groups. Current legislation (i.e., Forestry Act, 1946) requires forest owners to apply for a felling licence if they wish to fell trees; the granting of such a licence is accompanied by a requirement to reforest.

Increasing the level of forest cover in Ireland remains a key aim of government forest policy. The government's most recent forest strategy, *Growing for the Future* (DAFF 1996), laid out afforestation targets of 25,000 ha per annum to the year 2000 and 20,000 ha per annum thereafter. Seventy percent of the planting was to be carried out by the private sector. The achievement of these targets was to be facilitated by the continued availability of grants and premiums. In the strategy, the case for this investment in forestry was made primarily on the basis of the ideal or target size for the industry (critical mass), the real rate of return on investment, future timber processing capacity and employment (*ibid*). Critical mass was defined as "the scale of timber production large enough to make true competition and the operation of market forces possible and to support a range of processing industries" (*ibid* p. 2) and was set at a minimum of 10 million m³ per annum. Annual timber production at the time the strategy was published was just over 2 million m³.

Since 1980, almost 20,000 landowners, mostly farmers, have afforested approximately 200,000 ha (4% of land cover) in Ireland. The availability of subsidies has been a key incentive (Ní Dhubháin and Gardiner 1994) and effectively no one engages in afforestation outside of the scheme. While the afforestation programme emphasises the importance of multi-functional forest management, those in receipt of grant-aid continue to be required to manage their forests for timber production (Forest Service 2003) and land afforested should be "capable of producing a commercial crop of wood" (*ibid* p.19). The procedures that should be carried out in grant-aided forests to ensure that such a crop of timber is produced, while taking appropriate environmental protection and control measures, are outlined in the Forestry Schemes Manual (*ibid*). Routine inspections of grant-aided forest plantations are carried out by Forest Service inspectors to ensure that management is on-going.

There is no tradition of farm forestry in Ireland, and many of those who have afforested are doing so for the first time. The vast majority of private forest owners have not got involved in the establishment of their forests (Ní Dhubháin and Wall 1999). Instead they hire management companies, the cost of which is covered in the establishment grant, to establish the forest over a period of 4 years. Thereafter, the owners typically assume the management of the forest and the involvement of management companies ceases (Maguire 2009). In the case of monoculture conifer plantations management input is low until the crop is due for first thinning, which is typically around year 20 of the rotation. Those plantations established in the initial years of the afforestation programme are now due to be thinned. Broadleaves, whether planted pure or in mixture, require more intensive management if a quality timber crop is to be produced.

Achieving critical mass will require forest owners to manage their forests for timber production, in the context of sustainable forest management. The question arises as to whether private forest owners know enough about forestry to ensure that their forests are managed to achieve this objective. This paper describes a study undertaken to identify the knowledge, among private forest owners in Ireland, of broad aspects of forest management. The study also set out to investigate if there is a link between the knowledge of forestry among private forest owners and the profile of these owners and their forests, in particular, whether those afforesting prior to the availability of premiums, knew more about forestry than those who afforested after premiums were made available. Finally, the uptake of extension services by private forest owners was explored.

Methods

This paper is based on the results of interviews conducted with a sample of owners of private forests in Ireland. In Ireland almost all private forest owners are in receipt of grant-aid from the Forest Service, thus the list of grant recipients retained by this organisation was used to represent the population. For the purpose of sampling, the population was divided into two strata: a prepremium stratum which comprised private forest owners who had planted prior to 1990 (the year forest premiums became available); premium stratum comprising private forest owners who had planted after 1989. The reasons for stratifying in this way were that:

1. the Forest Service retained information on these groups in separate databases;
2. it was hypothesised that those afforesting prior to the availability of premiums had a greater interest in, and therefore knowledge of, forestry than those who afforested after premiums were made available.

The total population was 8,428 individuals, of which 22% were in the prepremium stratum and 78% were in the premium stratum. The sample size was dictated by the cost of conducting personal interviews; a sample size of 100 respondents was considered the maximum possible given the resources available. Previous studies (e.g., Ní Dhubháin and Wall 1999) had indicated a response rate of

13–14% among private forest owners who had been invited to participate in surveys, thus invitations were sent by the Forest Service to 222 randomly selected individuals in the prepremium stratum and 778 randomly selected individuals in the premium stratum in the hope of achieving the desired sample size. A total of 170 respondents agreed to participate, and from these, a stratified random sample of 99 individuals was selected for survey; 21 prepremium and 78 premium respondents. Under restrictions imposed by the Freedom of Information Act, the Forest Service was required to contact the sample; similarly the Forest Service was not allowed release details of owners who refused to participate.

Each of the respondents was interviewed in their own home, and a questionnaire completed, during the summer months of 2004. The questionnaire was divided into three sections: section one contained questions that profiled the forest; section two contained questions that assessed the knowledge among respondents of forestry operations and issues; and section three contained questions that profiled the forest owner.

In an effort to summarise the responses to the many questions querying the respondents' knowledge of forestry a selection of these were chosen and the answers to these questions then "graded". This yielded an overall "score" indicating the knowledge of forest management among the private forest owners. Those who scored 40% or more in this test were classed as having passed the knowledge test, whereas those scoring less than this were considered to have failed. The choice of question to include in this test was guided by the advice of Teagasc (the Irish Agriculture and Food Development Authority) forestry advisors while the "correct" answer was classed as that given in the Forestry Schemes Manual (Forest Service 2003). As the focus of this study was to determine how much forest owners knew about forest management for timber production, the topics covered in the questions related to routine silvicultural operations that are carried out in Irish forest plantations. These topics included weed control, shaping of broadleaves, and the thinning and marketing of forest produce. Broadleaf shaping refers to the shaping process that the Forest Service (2003) recommends should be carried out early in the rotation to counteract heavy branching, forking and apical damage in broadleaf species, so as to ensure an adequate number of straight, good quality and apically-dominant stems for eventual final crop selection. In the interview, the respondents were given a diagram of a broadleaf tree and were asked to indicate which shoots should be removed in the shaping process and at what stage in the crop's development should this process of shaping begin. They were also asked to identify factors that might influence the price they would get for their timber. Finally, respondents were asked what indicator they would use to identify whether there was a need to control vegetation in their plantation.

Statistical Analysis

Logistic regression was used to determine which characteristics of the owners and their forests were associated with the owners passing the knowledge test. A model was fitted, which included all significant variables ($P < 0.05$), and odd ratios were generated for each of the significant factors, using this model. The 95% confidence

limits for these odds ratios were also calculated (Connolly and Reilly, 2000). Odd ratios, in this instance, show the odds of a forest owner passing the knowledge test in one set of conditions versus another. GENSTAT was the statistical software package used.

Results

Profile of Owners

The majority of those interviewed were male (83%) and aged between 50 and 65 years (42%) (Table 1). Most were full-time farmers. The majority of respondents (67%) had taken part in some level of agricultural education. Internet use among respondents was quite high (48%), but use-intensity was low with 63% of users using it occasionally or very rarely. A majority of respondents were members of farming and/or forestry groups (77%).

Profile of the Forest

Over half of respondents had a total forest area greater than 10 ha. The mean area planted was 26.72 ha, however the mode was between 5 and 10 ha. Forty-eight percent of those surveyed had planted conifer monocultures. Only 5% had planted broadleaves.

Table 1 Profile of private forest owners surveyed

Characteristic	Category	%
Gender	Male	83
	Female	17
Occupation	Full-time farmer	62
	Part-time farmer	32
	Non-farmer	6
Age	<30 years	1
	30 to <40 years	12
	40 to <50 years	23
	50 to <65 years	42
	≥65 years	22
Completed some/all secondary education		49
Completed some/all tertiary education		36
Participated in some element of formal agricultural education		67
Use internet		48
Member of farming and/or forestry groups		77
Read farming and/or forestry literature		89

Use of Extension Services

Teagasc is the main organisation responsible for forestry extension in Ireland. Just over one half of respondents had contacted Teagasc for advice on forest management (58%) and of these respondents, most had done so within the previous 4 years. The majority of respondents did not attend indoor training courses on forest management skills (83%) organised by Teagasc. Many reasons were given but being too busy and not being aware of such courses were mentioned most frequently (29% and 22%, respectively). Almost 30% believed that they had enough knowledge already, either of early stage forest management (15%) or of forest management in general (14%).

The majority of respondents (55%) had also not attended field days organised by Teagasc and the Forest Service although the attendance was higher than at indoor courses. Reasons put forward for this non-attendance was that respondents were too busy (41%) and the distance to the location of the field day events was excessive (22%). Amongst those that did attend, the most popular benefit gained was the ability to compare aspects of forest growth amongst peers.

Many respondents had planned to make use of the extension services provided by Teagasc in the future. The field days were also described as informative and giving rise to good discussions. The preferred option for extension services in the future were field days.

The most popular forestry topic that respondents would like to learn more about was timber marketing (57%). The thinning of conifers was also a topic of interest among respondents (49%). Teagasc was not the only source of information on forestry for private forest owners. Many of the respondents had contact with other forestry personnel currently.

Owners' Motivations and Goals

Respondents were asked why they had afforested their land. The most common response was 'to use up the marginal land' (40%) (Table 2). Other, more explicit economic motives, such as investment reasons or availability of grants/premiums were given by a further 30% of respondents.

Respondents were asked to identify the goals that they had for their forest and were asked to rank those goals. The majority of respondents identified 'to produce

Table 2 The primary reason why private forest owners had afforested land

Reason	%
To make use of marginal land	40
Investment/tax reasons	14
Avail of grants and premiums	11
Reduce farmwork	9
Make economic use of land	5
Like trees	4
Other reasons	17

timber for sale' as their primary goal (83%). Among secondary goals the provision of an 'ecological value' and the provision of 'cover for game and wildlife' were most frequently mentioned (30% each), while 10% gave timber production as a secondary or tertiary goal.

Involvement of Owners in Forest Activities

A distinction was made between the work carried out in forest establishment and the work post establishment. Just over half of those surveyed had participated in the work undertaken in their forest at establishment phase. Of these 70% were involved in weed control while over half had been involved in fencing the plantation. More respondents were involved in the work carried out after year 4 (76%). In particular respondents were frequently involved in the shaping of broadleaves (48%) and in the general maintenance of the forest (28%).

Respondents were asked to rank specified causes for their lack of involvement in small-scale forestry jobs. Lack of time (48%) and lack of knowledge (30%) were the two most popular reasons given.

Who Does the Work?

Respondents were asked various questions regarding the use of contractors. The majority of respondents did not currently have contractors or relatives managing their forests on their behalf (72%). Two-thirds of respondents expected to use forestry companies in the future to undertake work in their forest (66%).

Knowledge of Forestry

Just over two-thirds of respondents passed the knowledge of forestry test (68%). Respondents scored the best in the weed control and the marketing area (Table 3).

Logistic regression identified which characteristics of the private forest owners and their forests influenced their knowledge of forestry. The results showed that knowledge of forestry was independent of the characteristics of private owners' forests that were examined. Interestingly, knowledge of forestry was shown to be independent of stratum, i.e., there was no evidence that those who had planted prior to 1990 had more knowledge of forestry than those who planted for the first time after that date.

Of the owner-related characteristics only four were shown to be significantly related to knowledge of forestry ($P < 0.05$). These were: the age of the respondent;

Table 3 Pass rate of private forest owners in the four forest management areas

Topic	Pass rate (%)
Weed control	84
Shaping	45
Thinning	47
Marketing	60

Table 4 Factors shown to significantly ($P < 0.05$) influence whether forest owners passed the knowledge of forestry test

Characteristic	≤ 50 years		Member of group		Attended field days		Involved in establishment work	
	Yes	No	Yes	No	Yes	No	Yes	No
Pass (%)	86	57	75	44	82	56	78	58
Fail (%)	14	43	25	56	18	44	22	42
Deviance ratio	4.49		7.63		9.54		8.28	

Table 5 Odds ratios for factors influencing whether a forest owner passes the knowledge of forestry test

Characteristic	Odds ratio	95% confidence limits
≤ 50 years	4.22	(1.37–12.94)
Member of group	2.52	(0.84–7.55)
Attended field days	2.75	(0.96–7.88)
Involved in establishment work	1.77	(0.64–4.86)

whether they were a member of either a farming or forestry group; whether they had been involved in the silvicultural management of the forest at establishment phase; and whether they had attended a Teagasc field day (Table 4).

Respondents who were less than 51 years of age were just over 4 times more likely to pass the test than those who were older than 50 years (Table 5). Being a member of a forestry and/or agricultural group increased the odds of passing the test by 2.52; owners who attended field days were 2.75 more likely to pass the test than those who didn't attend field days.

Discussion

In most countries private forest management is primarily a voluntary action, often influenced by the goals and objectives of forest owners (Karppinen 1998). The situation that prevails in Ireland is different in that availing of subsidies when establishing forests requires the owner to manage the forest according to the principles of sustainable forest management but with timber production as a key priority. This requirement explains why so many of the forest owners surveyed indicated that their primary goal for their forests was timber production. This finding is in contrast with many studies on the objectives of private forest owners which found that private forest owners are a heterogeneous group with varying goals and objectives for their forests (Lönnstedt 1997; Ní Dhubháin et al. 2007). While some owners have timber production as their main objective (Kline et al. 2000; Mizaraitė and Mizaras 2005), these often account for less than 50% of all forest owners (Mizaraitė and Mizaras 2005; Karppinen 1998). It is also interesting

to note that despite the receipt of grant-aid being conditional on owners producing timber from their forests, a small minority did not include this as one of their objectives. This would suggest a mismatch between the objectives of the owner and the objectives of the afforestation programme under which their forest was established.

In order to assess the overall knowledge of forestry among those surveyed, some means of combining the information collected on individual forest operations had to be obtained. A decision was made to use a selection of the questions to generate an index of forest knowledge. The choice of question to include in this index was important and the advice of a number of Teagasc forestry advisors was obtained. Thus, in deciding the overall level of knowledge of forestry among private forest owners and the factors that influence it, it is important to recall that the knowledge relates to some key areas of forest management rather than all aspects.

Our analysis indicated that owner involvement in the silvicultural management at establishment stage was related to whether the owner passed the knowledge of forestry test, or not. However, it is not clear whether the owners gained the knowledge while undertaking these tasks or whether the knowledge levels facilitated their involvement in these tasks. Others (e.g., Wall 1997) have suggested that lack of knowledge hinders owners from getting involved in forest management and that by learning more about forest management, owners gain confidence which encourages them to get involved.

Forestry knowledge among younger owners (i.e., ≤ 50 years) was greater than that of older owners. Uliczka et al. (2004) similarly found that younger forest owners (i.e., < 55 years) scored higher in the general knowledge of biodiversity conservation test than older forest owners (i.e., > 55 years) but that both age groups had similar levels of forestry education. Why younger forest owners should have a greater knowledge is not clear. Initially it was hypothesised that younger owners would be more likely to be involved in the management of their woods, however, the results of statistical analysis did not support this.

Interestingly, none of the forest attributes were found to influence the owners' knowledge of forestry. Furthermore, our hypothesis that those who had planted under the pre-premium scheme have a greater knowledge of forestry than those who had planted in the premium scheme was rejected. This suggests that the pioneers of private forestry in Ireland, who planted trees when financial incentives were low, do not know more about forestry than those who established forests when financial incentives were high. In hindsight this is not as surprising a finding as it originally seemed. The pioneers, similar to those who planted later, had no tradition of forestry, and thus had no greater inherent knowledge base from which to draw from. Furthermore, it is important to note that it took some time for extension services in Ireland to respond to the rapid increase in private forestry and training and demonstrations were not available to private forests owners until 1991 (Wall and Ní Dhubháin 1998), when the forests owned by the pioneers were in the pre-thinning stage and where the need for advice and extension was relatively low. In reality, it is likely that pioneers had a greater genuine interest in, rather than knowledge of, forestry than those who planted purely to access the premium payments.

The key aim of forest policy in Ireland is to encourage afforestation so as to reach a target level of timber production that will make true competition possible (DAFF 1996). Thinning is considered a key element of the silvicultural management of forest plantations in Ireland (Forest Service 2003) and the only published forecast of roundwood production in private forests assumes that these forests will be thinned at regular intervals (Gallagher and O'Carroll 2001). The results of the knowledge of forestry test indicate that less than half of the respondents passed the thinning element of the test. Many of the plantations may not yet be due for thinning which may explain the lack of knowledge on the topic among respondents. Nevertheless, in Ireland's windy climate, the timing and intensity of thinning has significant consequences for crop stability and it is essential that owners have adequate and timely knowledge on the topic. On the positive side, respondents clearly recognise the importance of thinning, with over half of them identifying thinning as an area that they would like to learn more about. However, Teagasc have offered courses on thinning to private forest owners since 2002, thus it seems that many owners are not aware such courses exist or have chosen not to attend them. Reflecting the greater financial incentives for planting broadleaves than for conifers, the former are increasingly planted in monoculture or in mixture with conifers in private woodlands. In such plantations shaping is considered a key operation in quality timber production. The low pass rate for the shaping section of the knowledge test is therefore also of concern.

The low levels of knowledge, among owners, of aspects of the silvicultural management, call into question whether the timber production targets that form the basis of the financial support scheme in Ireland will be met. The forest management industry that emerged in Ireland, as planting by private landowners increased, has ensured that private plantations, have in the main, been successfully established despite the low levels of knowledge and lack of forestry tradition amongst the owners. However, there is evidence that many forest owners have no plans to avail of such services for the post-establishment management, and intend to undertake the management themselves (Maguire 2009). Such a move will require them to have, in the very least, a basic knowledge of the silvicultural operations that need to be conducted post-establishment.

One means of improving the knowledge of forestry among forest owners is through extension services. Harmon et al. (1997) found significant gains in knowledge among NIPF owners availing of forestry demonstrations. Blatner et al. (1991) found that the use of forestry assistance by forest owners was positively correlated with the number of management activities carried out. More specifically, Beach et al. (2005) noted that the provision of owner education and training were significant factors influencing timber production. The results from this study, which showed that owners that had attended field days were 2.75 times more likely to pass the knowledge of forestry test than those that had not attended these field days, support this assertion. Extension services have expanded substantially in Ireland in recent years and Teagasc, in conjunction with the Forest Service, offer a variety of indoor and outdoor forestry courses for private forest owners. However, uptake of these courses among forest owners is low. Only 17% had attended an indoor course while only 45% had attended field days. In previous surveys of Irish forest owners a

similar low level of attendance at courses was recorded (Ní Dhubháin and Wall 1999). A variety of reasons were given for not attending these courses, but only a small percentage was unaware that the courses were available. Given the key importance of extension services it may be necessary to make attendance at specified courses a perquisite for receipt of grant-aid. There is already a precedent for such a move in Ireland. Irish farmers who wish to participate in the Rural Environment Protection Scheme (REPS), which is a scheme which financially rewards farmers for farming in an environmentally friendly manner, must attend a 20-h course to be eligible to receive full REPS payments.

A limitation to the study is that although the sample that was invited to take part in the study was chosen at random, only those who agreed to do so were surveyed. Hence the sample was self-selected and it may represent a more enthusiastic or proactive set of forest owners than that which exists in the population as a whole. If so, the results present the best case scenario and the lack of knowledge among the owners may be even greater. It was not possible to assess non-response bias as the restrictions imposed by the Freedom of Information Act, meant that the Forest Service was not allowed release details of owners who refused to participate.

Conclusion

There is a long tradition of farm forestry throughout much of Europe and USA and hence, one would surmise, a greater knowledge of forest management among forest owners. In one sense, therefore, the situation in Ireland is relatively unique in a European context in that almost all private forest owners have only owned or established forests in the last 25 years. However, in another sense, the socio-demographic changes occurring within the forest ownership structure in Europe and USA, such as the aging and urbanisation of owners, as well the emergence of new forest owners mean that the traditional forestry knowledge base amongst forest owners is weakening. Thus the challenges that forest policy makers in Ireland face to achieve the critical levels of timber production may be replicated in other European countries.

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